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ABSTRACT

The literature describing deaf persons' intelligence was subjected to a quantitative and qualitative review in this analysis of 85 studies containing independent samples of 43,177 deaf subjects. First, bibliometric analyses were conducted to define the scope, dissemination, and trajectory of the research investigating deafness and Intelligence Quotient (IQ). Second, meta-analytic techniques were applied to the results of studies captured in the review. Bibliometric results showed that the field experienced steady but slow growth over time, yet the field remains isolated, disconnected, and nonexperimental in nature. Meta-analytic results showed deaf persons' nonverbal abilities were in the average range, but the type of tests affected IQs. Performance tests yielded slightly higher IQs than other nonverbal tests, and both yielded higher IQs than verbal tests. Genetically deaf persons had above-average IQs in contrast to the average IQs of nongenetically deaf persons or normal-hearing peers. It is concluded that environmental disadvantage clearly inhibits development of verbal intelligence and that nonverbal abilities are not affected by the environmental disadvantages experienced by deaf persons. It is proposed that deafness as a natural experiment might be better understood as a "disadvantaged minority" experiment, rather than a "language deprivation" experiment. (Author/JDD)

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DEAFNESS AS A NATURAL EXPERIMENT: A META-ANALYTIC REVIEW OF IQ RESEARCH[1]

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Abstract

The literature describing deaf persons' intelligence is subjected to a quantitative and qualitative review. Studies (N = 85) containing independent samples of deaf subjects (cumulative N = 43,177) were analyzed in two ways. First, bibliometric analyses were conducted to define the scope, dissemination, and trajectory of the research investigating deafness and IQ. Second, meta-analytic techniques were applied to the results of studies captured in the review. Bibliometric results show that the field experiences steady but slow growth over time, yet the field remains isolated, disconnected, and nonexperimental in nature. Meta-analytic results show deaf persons' nonverbal abilities are in the average range, but that the type of test affects IQs (Performance tests yield slightly higher IQs than other nonverbal tests, and both yield higher IQs than verbal tests). Likewise, genetically deaf persons have above-average IQs in contrast to the average IQs of nongenetically deaf persons or normal-hearing peers. It is proposed that deafness as a natural experiment might be better understood as a "disadvantaged minority" experiment, rather than a "language deprivation" experiment. Reframing the natural experiment condition highlights the potential benefits that research conducted on deaf persons' intelligence offers to the scientific community. However, the isolated, disconnected nature of the research threatens the achievement of this potential.

Introduction

The study of deaf persons' intelligence has long fascinated philosophers and psychologists because prelingual deafness denies natural acquisition of language. The ancient Greeks posited that deaf people were "dumb" (i.e., without reason), because they did not acquire or use language. Because thought is expressed in speech, and deaf persons did not acquire speech, it was assumed that deaf people lacked the ability to reason. This philosophy was encoded into laws and customs (e.g., inheritance of property to deaf people was denied), some of which still survive today.

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[1] This paper is based on excerpts from the author's forthcoming book, Deafness, Deprivation, and IQ. New York: Plenum Press.

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The separation of intelligence, or the ability to reason, from language fluency was first discerned by Rene DesCartes. He noted that deaf people in Paris developed a gestural language system, used this system to communicate with other deaf people, and did so without being formally taught the system either in the home or at school (at the time, schooling for deaf children was nonexistent). DesCartes also noted that gorillas in the Paris zoo did nothing of the sort, nor was there evidence that any nonhuman animal developed language systems. He therefore concluded that people were born with innate rationality, that deaf people also had this innate rationality despite their inability to talk, and therefore identified the natural experiment of deafness (as well as presaging the signing primate studies of the twentieth centuryby about 300 years).

Subsequent investigators studied deaf people in their attempts to sort out the effects of language deprivation on the development of the intellect. The notion of individual differences in intelligence is a relatively recent contribution to the long-standing debate over the relationship of language and thought. Individual differences in intellectual abilities were proposed in the late 1800s by Sir Francis Galton, and given direction through the work of Binet and other pioneers of the intellectual testing movement. The work of Pintner and Patterson (1915) is perhaps the first investigation using intelligence tests and deaf subjects. Pintner and Patterson concluded that deaf children were delayed 2-4 years in their intellectual development. From this point, it was concluded that language deprivation did not eliminate or severely constrain the development of intellectual abilities, but rather the lack of language slowed or retarded the growth of intellectual abilities.

Since the early 1900s, numerous investigations of deaf children's IQs have been conducted. The focus of this paper is to quantitatively summarize these investigations using

meta-analytic techniques. These techniques provide the means to combine information across studies, yielding greater statistical power and understanding of the condition under study than single studies or narrative reviews of research. The methods employed in this study are followed by presentation and discussion of selected results in order to define the scope, nature, and trajectory of research in this area.

Method

Data Sources

Published and unpublished literature describing the results of intelligence tests with deaf subjects were included in the study. Published references were identified by computer searches of Psychological Abstracts and Medline databases, contact with the manager of the Deafness Collection at Gallaudet University, and reviews of reference lists appearing in studies. Unpublished resources were identified through computer searches of Dissertations Abstracts International and ERIC databases, contact with the manager of the Deafness Collection at Gallaudet University, reviews of reference lists appearing in published and unpublished sources, and personal contact by letter and telephone to researchers in the field. Every attempt was made to capture existing references; sources were excluded only if: (a) they did not use a test of intelligence, or (b) they did not report deaf subjects' performance in a manner that allowed comparison with normal-hearing children (e.g., qualitative descriptions were accepted, but distribution-free results such as correlations were excluded). A total of 85 unique references are included in this report describing the results of 102 unique samples. Additional references are in the process of being analyzed as this report is written.

Subjects and Procedures

Subjects. The samples in the studies range from a minimum of 17 to a maximum sample size of 21,307, yielding a cumulative sample size of 43,177 subjects captured in 102 independent samples. Because one unpublished study, a survey conducted by the Office of Demographic Studies at Gallaudet University (Schildroth, 1976) constituted 49% of the cumulative sample size, it was hypothesized that the values of this sample might disproportionately affect the cumulative results. Additionally, Schildroth (personal communication, 1988) warned that the data contained in the study might be subject to an unusually high degree of error because of reporting difficulties. Therefore, the mean IQ reported in the Schildroth sample ($\underline{M}$ = 95.6) was compared to the cumulative mean IQ from the other studies (cumulative sample $\underline{N}$ = 18,846, $\underline{M}$ = 97.12, $\underline{SD}_M$ = 8.31). Because the mean IQ from the Schildroth data was well within one $\underline{SD}$ of the values from the other studies, the Schildroth data were included in subsequent analyses.

The majority of studies selected subjects from residential schools for the deaf, with only 6 preschool samples and one adult sample. Samples were taken primarily from North America, although a significant number of subjects (nearly 3,500) are captured in research from the United Kingdom and Germany. Less than 4% of the studies provided complete information regarding subjects (i.e., age, gender, race, type of school program, degree and onset of hearing loss, parental hearing status, and presence of additional handicaps). Estimates from partial data suggest that the majority of research samples children who are: (a) school age; (b) nearly balanced with regard to gender (slightly more males); (c) predominantly white; (d) attend residential schools using sign language instructional methods; (e) congenitally, severely to profoundly deaf; (f) have normal-hearing parents; and (g) have atypically high incidence rates of

additional handicapping conditions. To the degree that these attributes can be isolated, they are discussed separately in subsequent sections.

Procedures. The vast majority of children were given performance IQ tests (the Wechsler Performance Scales being used in the majority of studies), although verbal and nonverbal tests (e.g., the Ravens Progressive Matrices) were also used. Administration procedures were most often unstated; of those defining the type of administration, combinations of gestures, signs, and speech were most common, followed by simultaneous presentation of signs and speech. Deaf norms were used in 17% of the studies, and were only found for the Hiskey Nebraska Test of Learning Abilities and the Wechsler Intelligence Scale for Children-Revised (WISC-R) Performance Scale.

Data Analyses

Data regarding subjects, test performance, and other comments were gleaned from references and entered into a database. In references where multiple independent studies were presented (e.g., Ewing, 1957), a separate record was created to represent the results of each independent investigation. Ratio IQ data were recorded along with the SDs reported in the sample (if any). Data from deviation IQ tests which do not follow the Wechsler convention of M = 100 and SD = 15 were converted to this metric on the basis of normative data (e.g., a British Ability Scale, M = 50, SD = 10, IQ = 60, was converted to an IQ = 115), or on the basis of the mean and standard deviation reported for the sample if it was a nonstandard test of intelligence. Other data, such as whether hearing-impaired norms were used, subject descriptions, and significance of statistical tests used in the study, were obtained when possible.

Study data were analyzed in two ways. First, a bibliometric analysis of the research was attempted using descriptive statistics. This analysis describes the scope, nature, and trends in

research investigating the intellectual performance of deaf people. The second analysis manipulated the results of the studies in order to determine what conclusions can be drawn from the research (i.e., How does deafness affect IQ?).

Results

Bibliometric

Modes of dissemination. Of the 85 references identified in the literature search, 62 (73%) are published and 23 (27%) are unpublished studies. Published references appear in books (N = 2), deafness-related journals (N = 42), and nondeafness-related journals (N =18). The primary medium for unpublished studies is dissertations, with ERIC document reports, personally-solicited manuscripts (most of which are submitted for publication), and deafness-related newsletters (e.g., newsletters produced by residential schools) comprising the other unpublished media.

Rate of research. A common metric of a "healthy" research field is a curvilinear increase in the number of studies over time. The rate of increase in research regarding the intelligence of deaf people is positive and significant (r = .47, p < .01, between frequency of studies and year of publication), as displayed in Figure 1[2]. Although Figure 1 suggests a curvilinear increase in studies, comparison to the number of studies in learning disabilities research suggests a relatively low rate of growth for studies of deaf persons' intelligence. Figure 2 represents the cumulative number of studies in learning disabilities and IQ-related deafness research over the period from 1968-1982 (learning disabilities data taken from Summers, 1986, p. 54). Unlike robust fields of research, which characteristically double the

[2]Figures are placed at the end of the article before references.

knowledge base every 5-10 years, IQ research in deafness shows a slow rate of growth, with knowledge doubling every 18-20 years.

Effect Sizes

Overall comparison. Mean IQs ranged from 70.35 to 122, with a grand unweighted mean of 100.31, SD_M = 7.47. The global average, unweighted for sample size, was well within average limits, although the distribution of means (SD_M = 7.47) was larger than expected. The SD_M should be the standard error of the mean (i.e., much smaller than SDs). The SDs reported within studies ranged from 9.23 to 24.69, with an average of 16.01, SD_{SD} = 3.44. It should be noted that global comparisons used all IQ data, including dependent measures (i.e., if a study reported two mean IQs, each was entered as a separate data point in global analyses). Global indices are remarkably similar to normative data from normal-hearing children, although the variation of means among studies is unusually high.

Qualitative descriptions of cognitive performance correspond to the average IQs generated from quantitative descriptions. A total of 17 studies provided qualitative descriptions. Results were assigned to one of four categories: Educable Mentally Retarded/Borderline (N = 2), Low Average (N = 5), Average (N = 7), or Above Average (N = 3). It should be added that although qualitative descriptions appear to be somewhat lower than quantitative IQ data, the studies offering qualitative descriptions are typically outdated studies with poor descriptions of samples and methods (i.e., they appear to lack the rigor associated with quantitative studies).

Results by intelligence test types. Intelligence tests were assigned to one of four categories: (a) performance tests (requiring rapid manipulation of objects), (b) nonverbal tests (nonverbal tasks but no manipulation), (c) verbal tests (verbal content in items), and (d) other tests (not clearly classified or unknown). Studies investigating groups of individuals according to

parental hearing status were excluded from the analyses in order to avoid confounding test type and subject effects. The type of intelligence test used to obtain levels of intellectual performance affects the corresponding IQ. The mean Performance IQ ($\underline{N}$ = 72, Range 70.35 to 122, $\underline{M}_M$ = 98.67, $\underline{SD}_M$ = 7.06) is higher than the nonverbal ($\underline{N}$ = 9, Range 81.4 to 103.8, $\underline{M}_M$ = 93.21, $\underline{SD}_M$ = 6.71) and verbal results ($\underline{N}$ = 3, Range 83.9 to 89.35, $\underline{M}_M$ = 86.03, $\underline{SD}_M$ = 2.38) (see Figure 3). Because the "other tests" category includes such diverse instruments as adaptive behavior scales, teacher ratings, and electronic switching devices, data are not reported.

Parental hearing status. Although most studies fail to identify and report intelligence test data by the hearing status of the subject's parents, a subset of studies provided data for deaf children of hearing parents (HP), deaf children of deaf parents (DP), and deaf children of hearing parents who are genetically deaf (most of whom had a deaf sibling, or HP/DS). All studies in this analysis used performance IQ tests. The average PIQs for HP are consistently lower than those for DP and HP/DS. HP ($\underline{N}$ = 2,224) have a mean PIQ of 103.06 ($\underline{SD}_M$ = 5.22), and an average $\underline{SD}$ = 15.60. DP ($\underline{N}$ = 609) have a mean PIQ of 111.21 ($\underline{SD}_M$ = 3.97), and an average $\underline{SD}$ = 13.46. HP/DS ($\underline{N}$ = 191) have a mean PIQ of 109.22 ($\underline{SD}_M$ = 2.22), and an average $\underline{SD}$ = 13.95. These results are presented in Figure 4. It is important to note that DP and HP/DS groups not only outperform HP; they are also well above normal-hearing normative IQs. In fact, the mean reported for HP is inflated by the fact that three of the samples contributing to the mean matched HP to DP on the basis of IQ, thus inflating the representation of high IQs in the HP group. The consistency of studies (there are no mean PIQs below 102 for either DP or HP/DS) suggests the above average PIQs for these groups constitute a robust phenomenon.

Demographic differences in IQ. At this time, meta-analytic results are not available for comparisons regarding gender, race, age, or hearing loss of subjects. These results are expected to be prepared for presentation at the Second International Symposium on Cognition, Education, and Deafness.

Discussion

Bibliometric Results

The bibliometric results suggest that research linking intelligence and deafness is neglected relative to other fields of special education. This conclusion should be tempered by the fact that Figure 2 illustrates the total number of LD studies but only the fraction of deafness research that investigates intelligence. Still, it is clear from the long time frame it takes to double knowledge that work regarding intelligence among deaf persons is making steady but slow progress.

Why is this research field lethargic? On the one hand, researchers in deafness do not often publish outside their own journals, so there is little opportunity to attract the attention of a wide range of scholars. On the other hand, the lack of attention devoted to deafness in general literature may reflect a publication bias against including deafness-related research. A qualitative review of research methods suggests that researchers in deafness may be their own "worst enemies." Much of the research appears to be archival (i.e., nonexperimental retrieval of data from school records). Because these data are not linked to a specific experimental question, and because the methods used to collect and analyze data often lack the sophistication and control associated with experimental research, the results may well fail to meet the criteria expected for refereed review in nondeafness journals.

Although slow growth of research in the field is a problem, a second problem is the lack of direction among research projects in the field. Few studies are specific extensions of previous work. Many studies unwittingly replicate previous research, and few attempt experimental analysis of widely-held beliefs. For example, it has been said that Verbal IQ tests are inappropriate for use with deaf children, which is certainly true if they are used to infer global intellectual ability. However, the study of deaf children's verbal intellectual abilities (as opposed to scholastic achievement) has been virtually ignored in the research. We have no idea whether continued neglect and impoverishment of verbal stimulation leads to a deterioration in verbal reasoning abilities, or if low scores on such tests are merely an artifact of limited vocabularies.

The bibliometric data lead to three conclusions: (a) there is limited growth of knowledge regarding deaf children and intelligence; (b) the knowledge contained in this field is not disseminated outside deafness-related publications; and (c) there is little theoretical context or direction to the research. These are sobering conclusions for a field that claims a history spanning at least 300 years.

Effect Sizes

The global effect size is average, suggesting that deaf people have average intellectual abilities. However, this conclusion must be tempered with the subsequent findings that the global effect size obscures important differences between types of tests and groups of deaf children. In fact, because different methods and tests are used, and because some groups of deaf children are disproportionately represented in the literature, the scatter of the data across studies is unusually high. Therefore, the global effect size does not accurately represent deaf persons' intellectual abilities.

Type of test. Although it is common knowledge within deafness, it bears restating that deaf persons' verbal intellectual abilities are well below average. Furthermore, the mean verbal IQ (86.03) probably over-estimates deaf people's abilities. Even when deaf children and hearing children are matched according to reading ability, deaf children still perform one standard deviation (i.e., on an IQ scale, about 85) below normal-hearing children on psycholinguistic tasks (Moores, 1970). The question of whether the underlying verbal abilities are deficient, or whether the below-average performance is primarily due to test factors such as misunderstood directions, limited knowledge of spoken (as opposed to signed) language, or other factors, is still unknown. However, the research conducted by Moores suggests deaf persons' lack of verbal fluency may impair basic verbal reasoning skills.

The common assumption in deafness circles, that deaf children's nonverbal IQs are average, is not technically correct. Two types of nonverbal intelligence tests are used in the literature, and each yields slightly different results. Performance tests, which require manipulation of materials to solve problems, produce slightly higher IQs than nonverbal tests that do not involve manipulation of objects. This finding may mean that deaf children have at least average psychomotor skills that assist them on manipulation tasks, but they are at a relative disadvantage on tasks that may be nonverbal but are nonetheless facilitated by verbal mediation strategies.

IQ as a function of parental hearing status. Deaf children of deaf parents (DP) have above-average Performance IQs. This finding is further complicated by the fact that HP/DS children also have high PIQs. Three theories have been offered to account for this finding: (a) deaf parents provide a more supportive, nurturing environment than normal-hearing parents (Sisco & Anderson, 1980); (b) the (normal-hearing) test norms are abnormally low, so

genetically deaf children only appear to be above average (Conrad & Weiskrantz, 1981); and (c) there may be a genetic link between deafness and high IQ (Kusche, Greenberg, & Garfield, 1983).

Two of these theories can be comfortably dismissed. First, if it were true that deaf parents offer a better environment than normal-hearing parents (and there is no evidence to empirically support this post-hoc speculation), it is still not possible to account for HP/DS above-average IQs (Kusche et al., 1983). Second, the likelihood that the nationally-based stratified random-sampling techniques employed in the large scale norming of IQ could be systematically inadequate is simply untenable.

The third speculation, a genotypic link between genetic deafness and high IQ, is merely a tautology for what is already known, viz., genetically deaf children have above average IQs because they are genetically deaf. This statement is equivalent to saying white children have higher IQs than black children because they are white. The data needed to test this relationship (i.e., the data needed to discriminate within-family environmental effects from assortative mating effects or pleiotropic effects) are not to be found in the literature. I am working to attract funding and cooperation from appropriate agencies to collect the data needed to test this hypothesis, but at the present time, the anomaly is a mystery. However, the phenomenon of above average PIQs for DP and HP/DS is certainly robust because it has been noted across time, instruments, and continents.

Deafness as a Natural Experiment

It is appropriate to come full circle and reconsider the outcomes and the conditions of deafness as a natural experiment. First, what are the conditions associated with deafness? Although it has been widely assumed that the primary factor manipulated in deafness as a

natural experiment is language exposure (e.g., Furth, 1964; Vernon, 1967), it is by no means this simple. Recent research has shown that a number of factors are confounded with congenital deafness, including:

1. Auditory deprivation and distortion;
2. Delayed exposure to language;
3. Inconsistent, limited exposure to language;
4. Nonstandard language models;
5. Nonstandard language modalities, which have neurological processing capacities which are different from vocal-auditory modes;
6. Above average incidence of medical trauma;
7. Abnormal genetic endowment;
8. Dysfunctional family dynamics;
9. Below average socioeconomic status; and
10. Severe disadvantage in interactions with peers and society-at-large (including prejudice, discrimination, and isolation)(see Braden, 1988, for explication of these factors).

Of course, not all deaf children experience all of these factors. For example, DP do not suffer from delayed language exposure nor from exposure to a language that may be incorrectly adapted to visual-motor information-processing parameters (assuming they are raised by two parents who use sign language in the home). Likewise, DP are usually from low SES homes, but they do not experience abnormally high rates of medical trauma, and it is assumed (although not yet demonstrated) that DP have normal family dynamics. Conversely, most HP are from average SES homes, but some HP have normal genetic endowments, whereas others are deaf due to medical trauma. Not all deaf children experience these factors equally;

however, taken as a whole, deaf children are unusual relative to their unimpaired, ethnic majority peers on these factors.

The confounding of multiple factors raises the question of what experimental condition deafness emulates. I propose that deafness may be better characterized as a "disadvantaged minority" experiment than a "language deprivation" experiment. Comparison on the factors confounded with deafness suggests that deaf children experience equal or greater environmental disadvantage than most ethnic minorities. If true, the results of this meta-analysis can be used to raise questions about IQ differences between groups.

The first conclusion in this frame of reference would be that environmental disadvantage, clearly inhibits development of verbal intelligence. Deaf persons' Verbal IQs are strikingly similar to those of North American Blacks in that they are about one standard deviation below unimpaired ethnic majority peers. However, it should be remembered that the VIQ reported in this meta-analysis probably over-estimates deaf persons' Verbal IQs. Unfortunately, there are no data to test whether Verbal IQ tests are statistically biased for deaf persons, and therefore it is difficult to know whether the effect size reported for VIQ can be interpreted in the same way that VIQs can be interpreted for normal-hearing samples.

The second conclusion that is suggested in the concept of deafness as a disadvantaged minority experiment is that nonverbal abilities, especially Performance IQ, are not affected by the myriad environmental disadvantages experienced by deaf persons. In fact, DP (who come closest to representing a true ethnic minority, in that they share their status, language, and poor conditions with their parents) have above average PIQs relative to normal-hearing ethnic majority peers. This finding cannot be attributed to some artifact of testing (i.e., performance IQ tests have similar factor structure, reliability, stability, and validity in bothdeaf and normal-

hearing samples; Braden, 1984, 1985a, 1985b). In contrast, North American Blacks score one standard deviation below normal-hearing norms on Performance IQ tests.

These findings are provocative, and can quickly become controversial in the scientific-political arena surrounding society's current concerns over testing. The purpose of this paper is not to initiate such a debate within the International Symposium focusing on Cognition, Education, and Deafness; rather, it is to illustrate the potential value and application that the study of deaf persons' intelligence can have not only for the education and betterment of the deaf community, but for society at large. Unfortunately, the isolation of deafness research from the mainstream of scholarship is a dual-edged sword that cuts destructively both ways. Mainstream scholars are ignorant of work in deafness, even though it could play a significant role in the understanding of IQ differences between groups, the effects of environmental deprivation on intelligence, and other issues of import. However, ignorance of or indifference to the scientific and social issues to which our work could apply limits the value and quality of that work. Researchers in deafness need to actively break down barriers that divide themselves, and barriers that divide them from the larger scientific community. The Second International Symposium is surely a positive step toward overcoming barriers within deafness. Time will tell whether it also leads to overcoming the barriers that separate researchers in deafness from the mainstream of the scientific community.

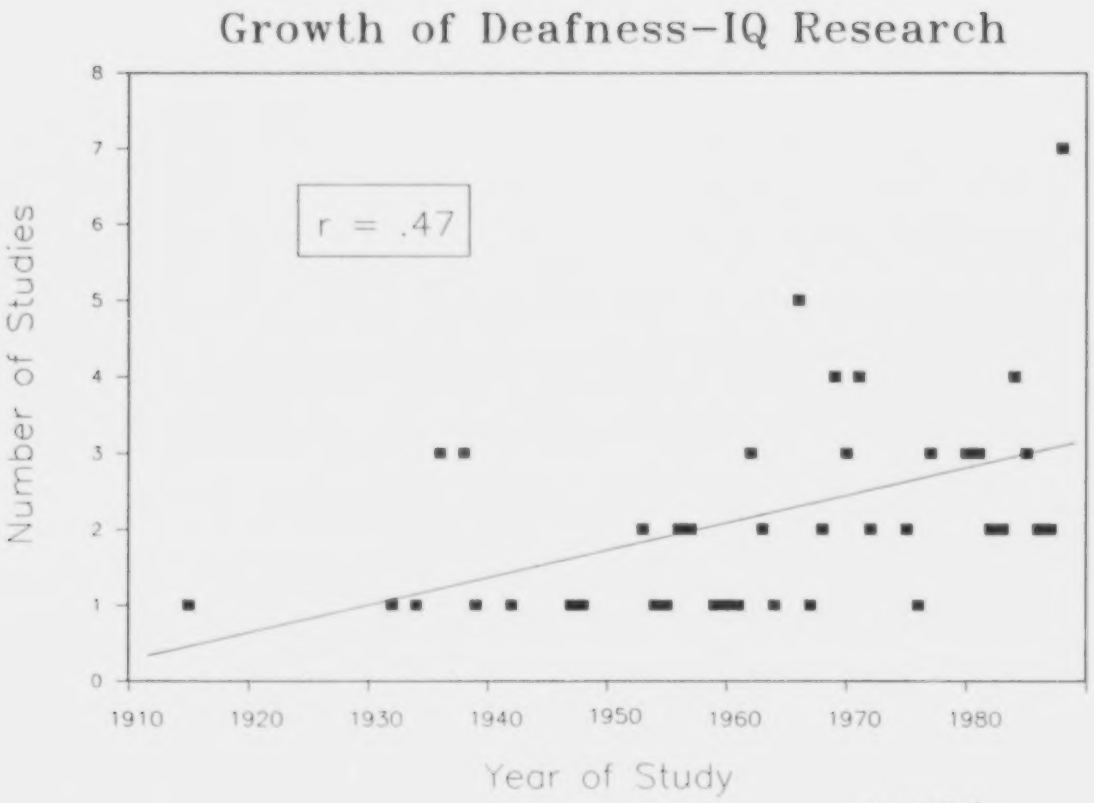

FIGURE 1

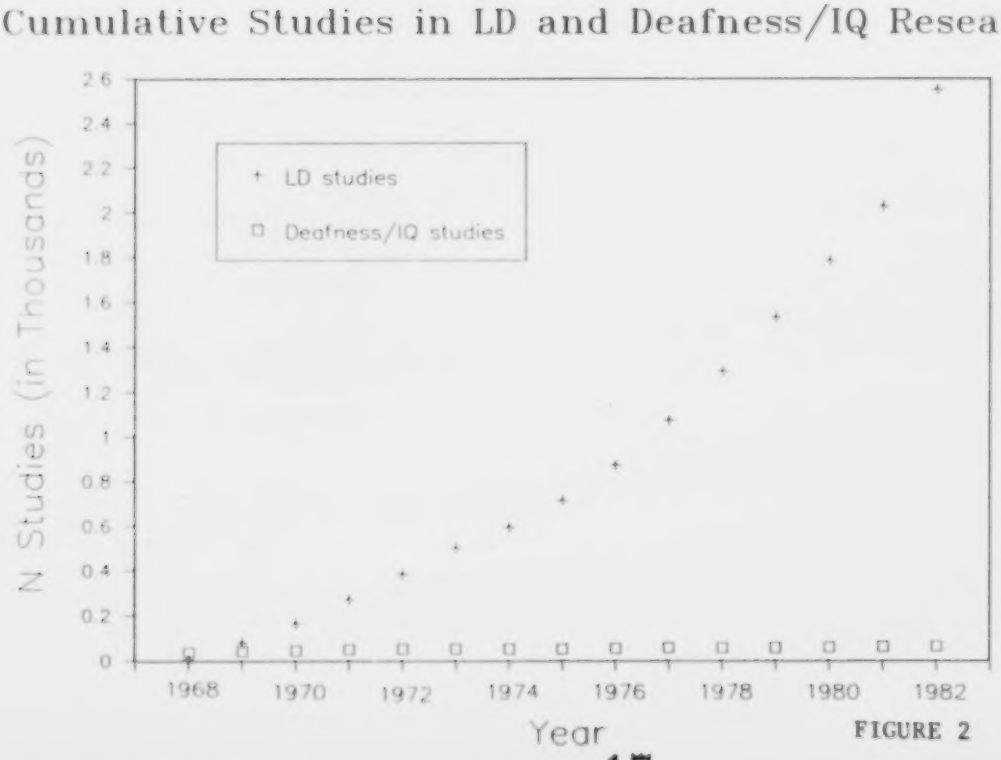

FIGURE 2

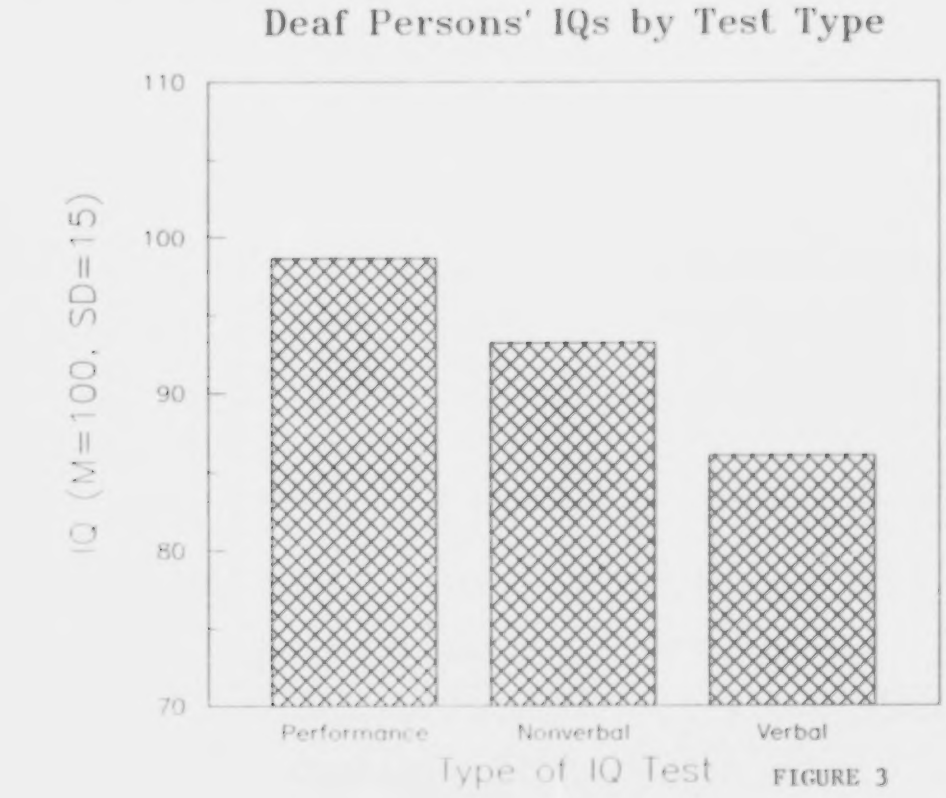

FIGURE 3

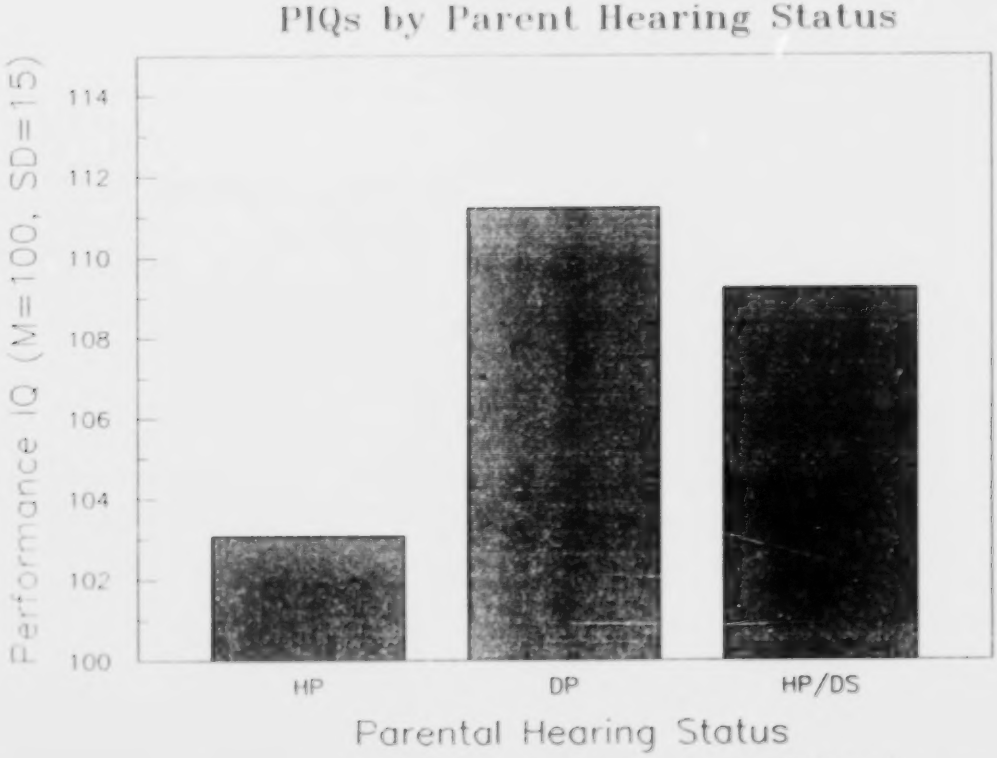

FIGURE 4

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